



STRATEGIES FOR IMPLEMENTING THREE BEST PRACTICES



NASA's Facilities Footprint

- **More than 5200 facilities**
- **44 million total square feet**
- **400,000 acres**
- **Over \$20 billion current replacement value**
- **~\$35 billion in R&D plant equipment**
- **Facility average ages is about 40 years**
- **75,000 people, including contractors**



NASA's Resource Consumptions:

- **Electricity:** 1.6 million MWH \$95M
- **Natural Gas:** 31 million Therms \$22M
- **Steam:** 247 billion BTU \$3.8M
- **Fuel Oil:** 2.5 million Gallons \$2.3M
- **Propane:** 188,000 Gallons \$0.2M
- **Water:** 2.5 billion Gallons \$4.4M
- **Total Energy:** ~10,000 billion BTU's/year



Integration of Three Best Practices:

- **Sustainable Design**
- **Design for Maintainability**
- **Total Building Commissioning**



NASA Facilities Program



DEFINITIONS & PRINCIPLES



NASA's View of Sustainability:

“Incorporates sustainable design practices, maintainable design elements, building commissioning procedures, and safety & security features into facility planning, design, construction, activation, operation & maintenance and deconstruction to enhance and balance facility life cycle cost, environmental impact, and occupant health, safety, security and productivity.”



Sustainable Design:

“A practice that involves planning, designing, constructing, activating and operating buildings to reduce the negative impact on the environment, minimize energy consumption, and promote the productivity, health and comfort of building occupants.”



Sustainable Design

- NASA has adopted the U.S. Green Building Council's LEED Standard for developing high performance sustainable buildings
- NASA has established a goal of meeting the LEED "Silver" rating for new building construction and major building renovations, starting in FY06



Maintainable Design:

“A practice that emphasizes the integration of operations and maintenance experience and principles into project planning, design and construction processes to achieve ease, accuracy, safety, and economy of maintenance tasks throughout the life of a facility.”



Building Commissioning (BCx):

“A quality process emphasizing procedures to ensure that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the owners project requirements.”



Safety & Security:

“Ensure project decisions include appropriate features to safeguard the health and welfare of facility visitors, occupants and equipment against internal hazards or external dangers (due to facility siting or terrorist activities).”



Total Building Commissioning (TBCx)



TBCx Overview



To better integrate the programming, design, construction and operation of all facilities in general, and

In support of Executive Order 13123:
NASA is adopting the Total Building Commissioning Process as a Best Practice



TBCx Overview



Because:

- **Building systems technologies are more complex**
- **Facilities are more complicated, and**
- **Interrelationships between systems are compounded**

We need:



Total Building Commissioning (TBCx):

The process of building commissioning applied to a wide variety of building systems, including but not limited to, structural, building envelope, thermal and moisture protection, doors, windows, equipment, special construction, conveying, mechanical, and electrical systems



Total Building Commissioning (TBXc):

- **Planning Phase**
- **Design Phase**
- **Construction Phase**
- **Activation Phase**



Implementing TBCx Process



Total Building Commissioning In The “Planning Phase”



Commissioning Activities:

- **Develop the Facility Project Requirements (FPR)**
 - Safety and Security Focus
- **Identify a Scope and Budget for the Commissioning Process**
- **Develop the Initial Commissioning Plan**
- **Accept the Planning Phase Commissioning Process Activities**



Implementing TBCx Process



Total Building Commissioning In The “Design Phase”



Commissioning Activities:

- **Verify the Design document to Facility Requirements Document**
- **Update the Commissioning Plan to include Construction & Activation Phase activities**
- **Insert TBCx requirements in the Construction Documents**
- **Establish Reliability Centered Building and Equipment Acceptance Criteria (RCB&EA)**



Commissioning Activities continued:

- **Develop Construction Quality Management tools**
- **Develop the Systems Manuals**
- **Define the training requirements**
- **Accept the Design Phase TBCx Process activities**



Implementing TBCx Process



Total Building Commissioning In The “Construction Phase”



Commissioning Activities:

- Update the Project Requirements and Commissioning Plan
- Develop detailed test procedures
- Verify that systems, and assemblies comply with the Construction Documents, FPR and RCB&EA criteria
- Produce of the Systems Manuals
- Train O&M personnel and occupants



Implementing TBCx Process



Total Building Commissioning In The “Activation Phase”



TBCx - Activation Phase



Commissioning Activities:

- Use the TBCx knowledge and experience to minimize contract warranty issues
- Provide ongoing guidance to maintain the FPR
- Complete seasonal testing of systems and assemblies
- Document lessons-learned
- Accept the Activation Phase TBCx Process



Summary:

- **NASA has integrated three of Industries Best Practices**
 - **Sustainable Design**
 - **Maintainability, and**
 - **Building Commissioning**
- **NASA has used various forms of BCx**



Summary Continued:

- **The next step - Total Building Commissioning (TBCx)**
- **Implementing TBCx is expected to:**
 - **Enable NASA to produce high performing, critical facility projects,**
 - **Improve facilities support to critical missions,**
 - **Provide practical experience, and**
 - **Generate lessons learned for future applications**